Exploring Equilibrium Mini-Lab

Lab Write-up: Answers to questions, graphs, data table. Group.

PART A.
Login to the computer and open a web browser. Go to http://phet.colorado.edu. Click "Play with Sims," then find the "Chemistry" section, and choose "Reactions and Rates." When the simulation is open, click on the "Many Collisions" tab.

Look at the screen and observe everything you can find out about the reaction pictured, A + BC → AB + C.

1) What type of reaction is it? Is it endo or exothermic?

2) **Predict** what will happen when 50 A's are added to the box and 50 BC's are added.

3) In the box labeled "current amounts," enter 50 for A and 50 for BC.
   a) Was your prediction correct? Describe and *explain* any differences.

   b) Describe the nature of dynamic equilibrium when small numbers of particles (such as 50, as compared to 6.022×10^{23}) are present.

4) **Predict** what will happen when the temperature is raised so it is NOT above the activation energy max but IS above the energy level of the products.

5) Raise the temperature as described. Did your prediction come true? Describe and *explain* any differences.

6) **Predict** what will happen when the temperature is raised so it is above the activation energy max.

7) Raise the temperature as described. Again, was your prediction correct? Describe and *explain* any differences.

8) What did you notice about the *rate* at which reactants/products fluctuated between the three different temperatures? If you didn't notice anything, hit "reset all" and test it again.

9) Did temperature affect equilibrium position? Did it affect it in the *way* you expected? Explain.

10) Did temperature affect reaction rate? Did it affect it in the *way* you expected? Explain.

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11) Write the equilibrium *expression* for this reaction. Because of the way the numbers fluctuate, it would be hard to calculate the equilibrium constant, but how *would* you do it if the numbers ever settled down?

PART B:

You should have 2 large beakers (1000 mL, labeled A and B) and 2 small beakers, 100 mL and 50 mL.

a) Fill one of the large beakers ("A") about 2/3 full of water. Leave the other beaker ("B") empty.
b) Record the volume of water in beaker A.
c) Transfer water between the beakers as follows: the person with the 100 mL beaker should use it to transfer water from A to B; the person with the 50 mL beaker should use it to transfer water from B to A. Fill the small beakers as full as possible **without tipping the large beakers** in any way.
d) Each cycle consists of one A → B transfer and one B → A transfer. **For each cycle**, record the volume of water in beakers A and B.
e) Continue pouring water from one reservoir to another and recording the volumes.
f) When no further changes are observed in the level of water in beakers A and B, define "equilibrium" for this analogy and explain how/why it is achieved.

1. In Excel, graph the volumes of water in beakers A and B per cycle. In the space below, describe your graph. What does this graph remind you of?

2. What does the ratio of volume of water in beakers A & B at equilibrium represent compared to chemical reactions?

3. What would be different and what would be the same if the water game were repeated with the beaker A only half full? With beaker A empty and beaker B 2/3 full? (Try it if you are unsure!)